PATENT ABSTRACTS OF JAPAN

(11)Publication number : 10-255998
(43)Date of publication of application : 25.09.1998

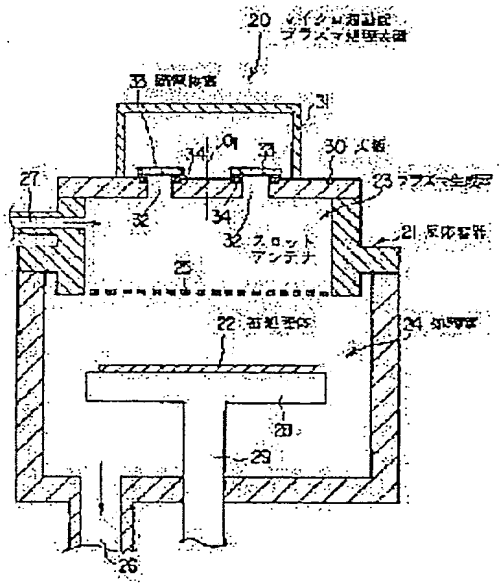
(51)Int.Cl. H05H 1/46
C23F 4/00
H01L 21/3065

(21)Application number : 09-051507
(22)Date of filing : 06.03.1997

(71)Applicant : TOSHIBA CORP
(72)Inventor : YAMAZAKI OSAMU

(54) MICROWAVE EXCITED PLASMA PROCESSING DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a microwave excited plasma processing device capable of efficiently transmitting a microwave in which a dielectric window is never broken by the force added by pressure or the transfer of heat by forming the dielectric window to a size corresponding to a microwave inlet port, and changing its arrangement to a conventional device.
SOLUTION: A reaction vessel 21 is formed of a plasma generating chamber 23 situated on the upper side, and a processing chamber 24 for arranging a matter 22 to be treated, which is formed under the plasma generating chamber 23. A slit-like slot antenna 32 which is a microwave inlet port is formed on a top plate 30 formed in the upper part of the plasma generating chamber 23. A gas supplying pipe 27 for supplying a processing gas into the plasma generating chamber 23 is provided. A waveguide 31 for introducing the microwave from the microwave inlet port 23 to the plasma generating chamber 23 is connected to the reaction vessel 21. A dielectric window 33 is formed in a size corresponding to the microwave inlet port 32 to airtightly block the microwave inlet port 32 and transmit the microwave.



LEGAL STATUS

[Date of request for examination] 05.03.2004

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] The reaction container which has the processing room where it is formed down a plasma production room and this plasma production room above the interior, and a processed object is arranged, The microwave inlet of the shape of a slit formed in the up wall of the above-mentioned reaction container, The gas supply line which supplies raw gas to the above-mentioned plasma production interior of a room, and the waveguide which is connected to the above-mentioned reaction container and introduces microwave from the above-mentioned microwave inlet to the above-mentioned plasma production room, Microwave excitation plasma treatment equipment characterized by providing the dielectric window which is formed in the magnitude corresponding to the above-mentioned microwave inlet, blockades this microwave inlet airtightly, and penetrates the above-mentioned microwave.
[Claim 2] The above-mentioned dielectric window is microwave excitation plasma treatment equipment according to claim 1 characterized by being prepared so that the above-mentioned microwave inlet may be covered from the upper part side of the up wall of a reaction container.
[Claim 3] The above-mentioned dielectric window is microwave excitation plasma treatment equipment according to claim 1 characterized by being prepared so that the vacuum lock of the above-mentioned microwave inlet may be carried out from the lower part side of the up wall of a reaction container.
[Claim 4] The above-mentioned microwave inlet is microwave excitation plasma treatment equipment according to claim 1 characterized by preparing a dielectric window so that the top-face side may be formed in the level difference configuration broader than an inferior-surface-of-tongue side and it may be stopped by this level difference configuration.
[Claim 5] The above-mentioned microwave inlet is microwave excitation plasma treatment equipment according to claim 1 characterized by forming opening by the side of a top face in the taper section larger than opening by the side of an inferior surface of tongue, and preparing the above-mentioned dielectric window in this taper section airtightly.
[Claim 6] The reaction container which has the processing room where it is formed down a plasma production room and this plasma production room above the interior, and a processed object is arranged, The microwave inlet formed in the up wall of the above-mentioned reaction container, and the gas supply line which supplies raw gas to the above-mentioned plasma production interior of a room, The waveguide which is connected to the above-mentioned reaction container and introduces microwave from the above-mentioned microwave inlet to the above-mentioned plasma production room, The dielectric window which is formed in the magnitude corresponding to the above-mentioned microwave inlet, blockades this microwave inlet airtightly, and penetrates the above-mentioned microwave, Microwave excitation plasma treatment equipment characterized by providing the dielectric member which spreads the microwave of the above-mentioned up wall which it was mostly countered and prepared at least in the whole, and carried out incidence from the above-mentioned microwave inlet to the upper part side inside the above-mentioned reaction container.
[Claim 7] The above-mentioned dielectric member is microwave excitation plasma treatment equipment according to claim 6 characterized by the thing of the above-mentioned up wall

formed so that the side attachment wall of the above-mentioned plasma production room might also be covered while being mostly prepared in the whole face to face at least at the upper part side inside the above-mentioned reaction container.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the microwave plasma treatment equipment used for etching and ashing in manufacture of a semiconductor device etc.
[0002]
[Description of the Prior Art] As conventional microwave excitation plasma treatment equipment, the thing of the structure shown in drawing 8 (a) and (b) is known. The reaction container 2 is formed in microwave excitation plasma treatment equipment 1. A top plate 3 is attached in an upper limit part, the rectangle-like waveguide 4 is attached further up, and the reaction container 2 forms a part for microwave induction. The slot antenna 5 of the shape of a slit as a microwave inlet which introduces microwave caudad is formed in the top plate 3. The direction of the incidence side of microwave is formed more broadly than the edge wall 4a, i.e., reflection of microwave, side of this waveguide 4, and this slot antenna 5 is formed in narrow a little in the halfway section of a slot antenna 5 toward the reflection side from the incidence side.
[0003] It is attached so that this top plate 3 may be countered and a dielectric window 6 may blockade the above-mentioned reaction container 2 airtightly through the seal member of O ring 7 grade under the above-mentioned top plate 3. The reaction container 2 is divided up and down with the diffusion plate 8 at the plasma production room 9 and the processing room 10 of a cylindrical shape. The gas supply piping 11 is connected to the side attachment wall by the side of this plasma production room 9, for example, raw gas like oxygen is supplied to the interior.
[0004] A revolving shaft 12 is attached in an inferior surface of tongue, and the wafer holder 14 which has predetermined spacing and lays the wafer 13 which is a processed object up from the above-mentioned diffusion plate 8 is formed in the processing room 10 interior.
[0005] the exhaust pipe way 15 which carries out vacuum suction of the reaction container 2 interior of the above is formed in the base of the processing room 10, and it connects with the suction pump prepared outside -- having -- the pressure of this reaction container 2 interior -- low voltage -- suction actuation is carried out like.
[0006] With such microwave excitation plasma treatment equipment 1 of a configuration, after making internal pressure into low voltage by vacuum suction, raw gas is supplied to the plasma production room 9 interior of the above by the gas supply piping 11. And after supplying raw gas, microwave is introduced into the interior through the above-mentioned waveguide 4, a top plate 3, and a dielectric window 6, and raw gas is plasma-ized. The above-mentioned diffusion plate 8 is passed, homogeneity distributes, and the plasma-ized raw gas is introduced into the processing room 10 interior, and carries out plasma treatment of the wafer 13 on the wafer holder 14.
[0007]
[Problem(s) to be Solved by the Invention] By the way, with above-mentioned microwave excitation plasma treatment equipment 1, the pressure of the space part formed by the top plate 3 and the waveguide 4 has become almost equivalent to atmospheric pressure, and vacuum suction is carried out and the reaction container 2 interior serves as low voltage. Therefore, it will go caudad from the upper part of a dielectric window 6, and a dielectric window 6 will be

joined through the slot antenna 5 formed in the top plate 3 by the force produced by this differential pressure. In order to obtain the required reinforcement for supporting the stress added by this differential pressure, it is necessary to thicken the above-mentioned dielectric window 6 and to raise reinforcement.
[0008] However, if a dielectric window 6 is thickened, the problem that loss of the microwave introduced in the processing room 10 will become large at the time of dielectric window 6 transparency is produced. Moreover, in addition to this, generating of the plasma in the processing room 10 interior produces heat, and this heat is transmitted to the inferior-surface-of-tongue side of the above-mentioned dielectric window 6, and it produces the temperature rise of a dielectric window 6. Therefore, in addition to the stress produced from a top-face side by the differential pressure which goes to an inferior-surface-of-tongue side, the generating heat of the plasma is transmitted to a dielectric window 6 from an inferior-surface-of-tongue side, for this reason the dielectric window 6 is it is much more easy to be destroyed.
[0009] The place which this invention was made based on the above-mentioned situation, and is made into the purpose does not have breakage of the dielectric window by transfer of the force and heat which are added with a pressure, and it is going to offer microwave excitation plasma treatment equipment with possible making microwave transmit efficiently.
[0010]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem, invention according to claim 1 The reaction container which has the processing room where it is formed down a plasma production room and this plasma production room above the interior, and a processed object is arranged, The microwave inlet of the shape of a slit formed in the up wall of the above-mentioned reaction container, The gas supply line which supplies raw gas to the above-mentioned plasma production interior of a room, and the waveguide which is connected to the above-mentioned reaction container and introduces microwave from the above-mentioned microwave inlet to the above-mentioned plasma production room, It is microwave excitation plasma treatment equipment characterized by providing the dielectric window which is formed in the magnitude corresponding to the above-mentioned microwave inlet, blockades this microwave inlet airtightly, and penetrates the above-mentioned microwave.
[0011] Invention according to claim 2 is microwave excitation plasma treatment equipment according to claim 1 characterized by preparing the above-mentioned dielectric window so that the above-mentioned microwave inlet may be covered from the upper part side of the up wall of a reaction container.
[0012] Invention according to claim 3 is microwave excitation plasma treatment equipment according to claim 1 characterized by preparing the above-mentioned dielectric window so that the vacuum lock of the above-mentioned microwave inlet may be carried out from the lower part side of the up wall of a reaction container.
[0013] As for invention according to claim 4, the top-face side of the above-mentioned microwave inlet is microwave excitation plasma treatment equipment according to claim 1 characterized by preparing a dielectric window so that it may be formed in the level difference configuration broader than an inferior-surface-of-tongue side and may be stopped by this level difference configuration.
[0014] The above-mentioned microwave inlet is formed in the taper section with opening larger than opening by the side of an inferior surface of tongue by the side of a top face, and invention according to claim 5 is microwave excitation plasma treatment equipment according to claim 1 characterized by preparing the above-mentioned dielectric window in this taper section airtightly.

[0015] The reaction container which has the processing room where invention according to claim 6 is formed down a plasma production room and this plasma production room above the interior, and a processed object is arranged, The microwave inlet formed in the up wall of the above-mentioned reaction container, and the gas supply line which supplies raw gas to the above-mentioned plasma production interior of a room, The waveguide which is connected to the above-mentioned reaction container and introduces microwave from the above-mentioned microwave inlet to the above-mentioned plasma production room, The dielectric window which is

formed in the magnitude corresponding to the above-mentioned microwave inlet, blockades this microwave inlet airtightly, and penetrates the above-mentioned microwave, It is microwave excitation plasma treatment equipment characterized by providing the dielectric member which spreads the microwave of the above-mentioned up wall which it was mostly countered and prepared at least in the whole, and carried out incidence from the above-mentioned microwave inlet to the upper part side inside the above-mentioned reaction container.
[0016] Invention according to claim 7 is microwave excitation plasma treatment equipment according to claim 6 with which the above-mentioned dielectric member is characterized by the thing of the above-mentioned up wall formed so that the side attachment wall of the above-mentioned plasma production room might also be covered while being mostly prepared in the whole face to face at least at the upper part side inside the above-mentioned reaction container.

[0017] According to invention of claim 1, since the above-mentioned dielectric window is prepared so that it may be formed in the magnitude corresponding to the above-mentioned microwave inlet and this microwave inlet may be blockaded airtightly, it can form area of this dielectric window into small area. Moreover, since the dielectric window was formed into small area, the force in which it is added below by differential pressure also becomes small, and even if it therefore makes thickness of a dielectric window thin, it becomes possible to bear the stress produced by differential pressure.
[0018] Moreover, it is also possible to lessen transmission loss of microwave by the dielectric window which became thin. Furthermore, since the above-mentioned dielectric window is formed in the magnitude corresponding to the above-mentioned microwave inlet, heat joins only a comparatively small part, and in the top-face side, since it is open for free passage to the waveguide, even if this heat is added, it emits to a waveguide side and the temperature of this dielectric window is not rising.
[0019] According to invention of claim 2, since the above-mentioned dielectric window is prepared so that the slit microwave inlet of the above may be covered from the upper part of the up wall of a reaction container, the force by the differential pressure which joins a dielectric window becomes small. Moreover, transfer of the heat from a plasma production room becomes small, and, comparatively [the], becomes possible [making good heat dissipation nature of the heat inside a waveguide].
[0020] Moreover, for a **** reason with picking, it becomes easy to attach the above-mentioned dielectric window to the dielectric window to this up wall so that it may cover from the upper part of an up wall. According to invention of claim 3, since it is prepared so that the vacuum lock of the above-mentioned microwave inlet may be carried out from the lower part side of the up wall of a reaction container, a dielectric window does not project to the interior side of a waveguide, and the above-mentioned dielectric window becomes what has without [good] therefore barring convective [of the microwave inside a waveguide], and can make good permeability of the microwave to the plasma production room of this dielectric window lower part.
[0021] Since according to invention of claim 4 the dielectric window is prepared so that a top-face side may be formed in a level difference configuration broader than an inferior-surface-of-tongue side and the above-mentioned microwave inlet may be stopped by this level difference configuration, Since it was prepared in the level difference configuration while having the advantage that a dielectric window did not spoil convective [of microwave], without the ability projecting to the interior side of a waveguide, the stop nature of a dielectric window can be raised and the heat dissipation nature of the dielectric window of a parenthesis is not spoiled.
[0022] Since according to invention of claim 5 the above-mentioned microwave inlet is formed in the taper section with opening larger than opening by the side of an inferior surface of tongue by the side of a top face and the above-mentioned dielectric window is airtightly prepared in this taper section, while becoming possible to keep good the vacuum lock nature of this microwave inlet, it is lost that this dielectric projects in the interior side of a waveguide, and barring convective [of microwave] therefore is lost.
[0023] Moreover, since the top-face side of a dielectric window is formed more widely than an

inferior-surface-of-tongue side, it becomes possible to transmit heat dissipation of the heat transmitted by the inferior-surface-of-tongue side of this dielectric window to the top-face side where area is more large, and to perform it, and it becomes possible to make heat dissipation nature good therefore.
[0024] While the above-mentioned dielectric window is prepared according to invention of claim 6, the dielectric member which spreads the microwave which carried out incidence from the above-mentioned microwave inlet further to the upper part side inside the above-mentioned reaction container Since [of the above-mentioned up wall] it is mostly prepared face to face over the whole at least, If microwave spreads the above-mentioned dielectric member, it will be prevented that a bias arises in the field strength of microwave inside this plasma production room, and it will become possible to make microwave transmit to homogeneity along with the above-mentioned dielectric member of it therefore. Therefore, it becomes possible to generate the plasma inside a plasma production room to homogeneity.
[0025] According to invention of claim 7, since [of the above-mentioned up wall] it is formed so that the side attachment wall of the above-mentioned plasma production room may also be covered while countering the whole mostly at least, it becomes possible for this side-attachment-wall side to also generate the plasma of the above-mentioned dielectric member, and it becomes possible to generate the more uniform plasma of it inside the above-mentioned plasma production room therefore at the upper part side inside the above-mentioned reaction container. Moreover, since the dielectric member was prepared also in the above-mentioned side-attachment-wall side, it is possible to prevent the chemical reaction of the side attachment wall by generating of the plasma inside this plasma production room.
[0026]
[Embodiment of the Invention]
(Gestalt of the first operation) The gestalt of operation of the first of this invention is hereafter explained based on drawing 1 . Although drawing 1 is the sectional side elevation showing the configuration of microwave excitation plasma treatment equipment 20, the microwave excitation plasma treatment equipment 20 shown in this drawing carries out incidence of the microwave to the reaction container 21 interior, and processes to the processed objects 22 prepared in the reaction container 21 interior using this microwave by which incidence was carried out, such as a liquid crystal substrate and a semi-conductor wafer.
[0027] The diffusion plate 25 which classifies this upper part side into the plasma production room 23, and classifies a lower part side into the processing room 24 is formed in the reaction container 21 interior of the above. The upper part side of this diffusion plate 25 serves as the above-mentioned plasma production room 23, after medium gas is supplied by the medium gas supply duct 27 mentioned later, microwave is introduced, and this medium gas is plasma-ized. This diffusion plate 25 is formed from mesh-like punched metal, and the concentration of the above-mentioned active species in the above-mentioned processing room 24 is moderately equalized with this diffusion plate 25. The active species diffused with this diffusion plate 25 processes etching of the above-mentioned processed object 22 etc.
[0028] The exhaust pipe way 26 connected with the vacuum pump with which an other end side is not illustrated is connected to the pars basilaris ossis occipitalis inside [processing room 24] the above, and air inside [reaction container 21] the above is attracted, and it is considering as the high vacuum. Moreover, the other end of the medium gas supply duct 27 connected with the source of medium gas supply in which an end side is not illustrated is connected to the side attachment wall of the above-mentioned plasma production room 23. Therefore, after making the reaction container 21 interior of the above into a high vacuum by such exhaust pipe way 26, medium gas like oxygen is supplied to the reaction container 21 interior by the medium gas supply duct 27.
[0029] The wafer holder 28 which lays the above-mentioned processed object 22 is formed in the pars basilaris ossis occipitalis inside [processing room 24] the above. Driving force is transmitted from the driving source which the revolving shaft 29 is connected caudad, and this revolving shaft 29 projects this wafer holder 28 from the pars basilaris ossis occipitalis of the above-mentioned processing room 24, and is not illustrated.

[0030] The top plate 30 formed from the metal plate is formed in the upper part of the above-mentioned plasma production room 23, and this plasma production room 23 is blockaded. Moreover, it is prepared above this top plate 30 so that the rectangle-like waveguide 31 with which microwave is introduced may cover a part of this top plate 30. It connects with the oscillator which does not have an end side illustrated, and this waveguide 31 introduces the microwave generated with this oscillator to up to the above-mentioned top plate 30 with the above-mentioned waveguide 31. This waveguide 31 has reflector 4a which is formed considering dielectrics, such as quartz glass, as the quality of the material, and reflects the incident wave of microwave in an other end side and which was shown by conventional drawing 8 .
[0031] The slot antenna 32 of the shape of a slit which is a microwave inlet is formed in the above-mentioned top plate 30 so that the longitudinal direction of the above-mentioned waveguide 31 may be met. The above-mentioned top plate 30 is open for free passage up and down, and this slot antenna 32 leads the microwave which transmitted the waveguide 31 interior of the above and arrived at the top-plate 30 above-mentioned upper part to the plasma production room 23 interior of the above. The above-mentioned slot antenna 32 is the medial axis O1 which has predetermined width of face as shown in drawing 1 , and is the core of the cross direction of the above-mentioned waveguide 31, and meets a longitudinal direction. It considers as the symmetry and is formed in one both sides at a time. Moreover, with the gestalt of this operation, the above-mentioned reflector 4a side is formed in narrow, and the above-mentioned slot antenna 32 is formed in a configuration to which an incidence side becomes broad from the location where predetermined went toward the incidence side of microwave from this reflector 4a.
[0032] However, the configuration of the above-mentioned slot antenna 32 may change not only this but various configurations and the numbers. The dielectric window 33 of the quality of the materials, such as SiO2, aluminum 2O3, AlN, and a fluororesin, is attached in such a slot antenna 32. By having the magnitude which is extent which can blockade the above-mentioned slot antenna 32, and being formed, and blockading this slot antenna 32, this dielectric window 33 is attached so that it may be possible to blockade the reaction container 21 interior of the above airtightly, and it may project inside [waveguide 31] the above through O ring 34.
[0033] According to the microwave excitation plasma treatment equipment 20 of such a configuration, the above-mentioned dielectric window 33 is formed in the magnitude corresponding to the above-mentioned slot antenna 32, therefore can form area of the above-mentioned dielectric window 33 into small area. Therefore, even if it makes thin thickness of the above-mentioned dielectric window 33, it becomes possible to bear the load which produces the waveguide 31 interior of the above by the differential pressure the circulating gas and inside [reaction container 21] the above.
[0034] Moreover, this dielectric window 33 that became thin enables it to lessen transmission loss of microwave. Furthermore, since the above-mentioned dielectric window 33 is formed in the magnitude corresponding to the above-mentioned slot antenna 32, heat joins only the comparatively small part of this dielectric window 33, and in the top-face side, since it is open for free passage to the waveguide 31, even if such heat is added, it emits by the above-mentioned waveguide 31 side, and the temperature of this dielectric window 33 is not rising.
[0035] As mentioned above, although the gestalt of 1 operation of this invention was described, this invention is variously deformable besides this, and with the gestalt of the above-mentioned implementation, although the dielectric window 33 is formed in the magnitude of wrap extent in the above-mentioned slot antenna 32, the above-mentioned dielectric window 33 may be formed in the sheet configuration with a superficial dielectric window 35, as shown such in not only a configuration but in drawing 2 . It becomes possible to reduce the area of the above-mentioned dielectric window 35 also in this case as compared with the conventional case.
[0036] (Gestalt of the second operation) The gestalt of operation of the second of this invention is hereafter explained based on drawing 3 . In addition, with the gestalt of this operation, and the gestalt of the first operation of a ****, the configuration of the wrap dielectric window 42 is only different from the configuration of the slot antenna 40 formed in the above-mentioned top plate 30 in this slot antenna 40 so that it may mention later. Hereafter, it explains to the thing of the

same configuration as the gestalt of implementation of the above first using the same sign.
[0037] The slot antenna 40 formed in the above-mentioned top plate 30 is formed so that the longitudinal direction of the above-mentioned waveguide 31 may be met, and the cross section of a parenthesis is formed for opening by the side of a top face in the shape of [larger than opening by the side of an inferior surface of tongue] a taper. That is, the above-mentioned slot antenna 40 has 1st taper section 40a in the halfway section of the top face and inferior surface of tongue of the above-mentioned top plate 30.
[0038] This slot antenna 40 is the medial axis O1 which is the core of the cross direction of the above-mentioned waveguide 31, and meets a longitudinal direction. It is made the symmetry and formed in these both sides, respectively. Moreover, with the gestalt of this operation, like the gestalt of implementation of the above first, the reflector 4a side which is the reflector of microwave is formed in narrow, and the above-mentioned slot antenna 40 is formed in a configuration to which the incidence side of microwave becomes broad from the predetermined location which goes to the incidence side of microwave from above-mentioned reflector 4a.
[0039] In accordance with this opening configuration, O ring 41 is not disrupted and is formed in the predetermined height location of taper section 40a of the above 1st at such a slot antenna 40. The dielectric window 42 which blockades the reaction container 21 interior of the above airtightly is attached through this O ring 41. In order to engage with taper section 40a of the above 1st through above-mentioned O ring 41, this dielectric window 42 has 2nd taper section 42a, and it is prepared so that this 2nd taper section 42a may contact above-mentioned O ring 41.
[0040] Thus, when taper section 42a of the above 2nd contacts above-mentioned O ring 41, the height of the above-mentioned dielectric window 42 is the height which does not project from the top face of the above-mentioned top plate 30.
[0041] According to the microwave excitation plasma treatment equipment 20 of such a configuration, since it stops to 1st taper section 40a of the above-mentioned slot antenna 40 and the top face of this dielectric window 42 projects in the interior side of the above-mentioned waveguide 31, the above-mentioned dielectric window 42 does not bar convective [of the microwave which is transmitting the waveguide 31 interior of the above].
[0042] Moreover, since the area by the side of the top face facing the above-mentioned waveguide 31 side of the above-mentioned dielectric window 42 is larger than the area by the side of the inferior surface of tongue facing the plasma-production room 23 where the plasma occurs and the interior serves as an elevated temperature, it can transmit the heat transmitted by the inferior-surface-of-tongue side of this dielectric window 42 to a large top-face side, and, for this reason, can make good heat-dissipation nature of the above-mentioned dielectric window 42.
[0043] Furthermore, since the stress produced by the differential pressure to the above-mentioned dielectric window 42 goes caudad from the upper part, the stop nature of taper section 42a of the above 2nd with above-mentioned O ring 41 will become good with the stress produced by this differential pressure, and will become possible [holding the airtightness of the above-mentioned reaction container 21 good].
[0044] As mentioned above, although the gestalt of 1 operation of this invention was described, in addition to this, this invention is variously deformable. Although 1st taper section 40a is formed in the slot antenna 40 and it has become that by which the above-mentioned dielectric window 42 is stopped by this 1st taper section 40a with the gestalt of the above-mentioned implementation, as for the configuration of the above-mentioned slot antenna 40, you may have not only this but the step 43 formed stair-like as shown in drawing 4 . In this case, the dielectric window 44 formed in this step 43 in the shape of sheet metal is stopped through O ring 41. And the top face of a dielectric window 44 does not project in the above-mentioned waveguide 31 side also in this case.
[0045] (Gestalt of the third operation) The gestalt of operation of the third of this invention is hereafter explained based on drawing 5 . In addition, the gestalt of this operation shall be explained about the gestalt of the first operation of a ****, and a common configuration using the same sign, in order to add the new requirements for a configuration to the gestalt of the first

operation of a ****.
[0046] Inside [plasma production room 23] the above, the dielectric plate 50 as a dielectric member formed in plate-like is formed in the location which estranged predetermined from the above-mentioned slot antenna 32. Since the microwave which passed the above-mentioned slot antenna 32 is introduced into homogeneity inside [plasma production room 23] the above, this dielectric plate 50 covers the upper part of this plasma production room 23 in the shape of a sheet, and is prepared.
[0047] In this case, since it is prepared in the plasma production room 23 interior and differential pressure has not arisen in a top-face and inferior-surface-of-tongue side, the above-mentioned dielectric plate 50 can be made the shape of sheet metal in the range which does not spoil this reinforcement.
[0048] According to the microwave excitation plasma treatment equipment 20 of such a configuration, it has become possible to make it spread along with this dielectric plate 50 of it, the microwave transmitted to the plasma production room 23 interior of the above makes microwave transmit to homogeneity by the lower part side of this dielectric plate 50 for that reason, and thereby, a bias does not have generating of the plasma in electrolysis reinforcement in the lower part of this dielectric plate 50, and it will become uniform.
[0049] For this reason, it is possible to process the above-mentioned processed object 22 to homogeneity further. In the above, although the gestalt of operation of the third of this invention was described, this invention is variously deformable besides this, and describes it below.
[0050] Although the dielectric plate 50 is what was formed in plate-like with the gestalt of implementation of the above third, as shown in drawing 6 , the configuration which uses the dielectric plate 60 formed in the shape of [which the top face was blockaded and the inferior surface of tongue opened wide] a cylindrical shape is also possible besides this. In this case, not only the top-face side of the above-mentioned plasma production room 23 but a side side can make it generate, and generation of the more uniform plasma is possible for generating of the above-mentioned plasma.
[0051] As mentioned above, although this invention was explained based on the gestalt of the first thru/or the third operation, this invention is possible also for gestalten other than the gestalt of these operations, for example, may be made the configuration which arranges a dielectric window 33 to the lower part side of a slot antenna 32 as shown in drawing 7 . In this case, the pawl-like stop section 70 which stops the above-mentioned dielectric window 33 is formed in the lower part side of the above-mentioned slot antenna 32, and it is good for this stop section 70 also as a configuration which carries out vacuum seal of the above-mentioned dielectric window 33 through O ring 71.
[0052] Moreover, although it has the composition that the reaction container 21 and the top plate 30 were separated, with the gestalt of the above-mentioned first thru/or the third operation, this reaction container 21 and top plate 30 may be formed in one. In addition, it is variously deformable.
[0053]
[Effect of the Invention] As explained above, since the above-mentioned dielectric window is prepared so that it may be formed in the magnitude corresponding to the above-mentioned microwave inlet and this microwave inlet may be blockaded airtightly, according to invention according to claim 1, it can form area of this dielectric window into small area. Moreover, since the dielectric window was formed into small area, the force in which it is added below by differential pressure also becomes small, and even if it therefore makes thickness of a dielectric window thin, the stress produced by differential pressure can be borne.
[0054] Moreover, it is also possible to lessen transmission loss of microwave by the dielectric window which became thin. Furthermore, since the above-mentioned dielectric window is formed in the magnitude corresponding to the above-mentioned microwave inlet, heat joins only a comparatively small part, and in a top-face side, since it is open for free passage to the waveguide, even if this heat is added, it emits to a waveguide side and the temperature of this dielectric window does not rise.
[0055] According to invention according to claim 2, since the above-mentioned dielectric window

is prepared so that the slit microwave inlet of the above may be covered from the upper part of the up wall of a reaction container, the force by the differential pressure which joins a dielectric window becomes small. Moreover, transfer of the heat from a plasma production room becomes small, and, comparatively [the], can make good heat dissipation nature of the heat inside a waveguide.
[0056] Moreover, for a **** reason with picking, it becomes easy to attach the above-mentioned dielectric window to the dielectric window to this up wall so that it may cover from the upper part of an up wall. According to invention according to claim 3, since it is prepared so that the vacuum lock of the above-mentioned microwave inlet may be carried out from the lower part side of the up wall of a reaction container, a dielectric window does not project to the interior side of a waveguide, and the above-mentioned dielectric window becomes what has without [good] therefore barring convective [of the microwave inside a waveguide], and can make good permeability of the microwave to the plasma production room of this dielectric window lower part.
[0057] Since according to invention according to claim 4 the dielectric window is prepared so that a top-face side may be formed in a level difference configuration broader than an inferior-surface-of-tongue side and the above-mentioned microwave inlet may be stopped by this level difference configuration, Since it was prepared in the level difference configuration while having the advantage that a dielectric window did not spoil convective [of microwave], without the ability projecting to the interior side of a waveguide, the stop nature of a dielectric window can be raised and the heat dissipation nature of the dielectric window of a parenthesis is not spoiled.

[0058] Since according to invention according to claim 5 the above-mentioned microwave inlet is formed in the taper section with opening larger than opening by the side of an inferior surface of tongue by the side of a top face and the above-mentioned dielectric window is airtightly prepared in this taper section, while becoming possible to keep good the vacuum lock nature of this microwave inlet, it is lost that this dielectric projects in the interior side of a waveguide, and barring convective [of microwave] therefore is lost.
[0059] Moreover, since the top-face side of a dielectric window is formed more widely than an inferior-surface-of-tongue side, it becomes possible to transmit heat dissipation of the heat transmitted by the inferior-surface-of-tongue side of this dielectric window to the top-face side where area is more large, and to perform it, and, therefore, heat dissipation nature can be made good.
[0060] While the above-mentioned dielectric window is prepared according to invention according to claim 6 The dielectric member which spreads the microwave which furthermore carried out incidence from the above-mentioned microwave inlet to the upper part side inside the above-mentioned reaction container Since [of the above-mentioned up wall] it is mostly prepared face to face over the whole at least, If microwave spreads the above-mentioned dielectric member, it is prevented that a bias arises in the field strength of microwave inside this plasma production room, and, therefore, it can make microwave transmit to homogeneity along with the above-mentioned dielectric member. Therefore, the plasma inside a plasma production room can be generated to homogeneity.
[0061] According to invention according to claim 7, since [of the above-mentioned up wall] it is prepared so that the side attachment wall of the above-mentioned plasma production room may also be covered while countering the whole mostly at least, it becomes possible for this side-attachment-wall side to also generate the plasma of the above-mentioned dielectric member, and it becomes possible to generate the more uniform plasma of it inside the above-mentioned plasma production room therefore at the upper part side inside the above-mentioned reaction container. Moreover, since the dielectric member was prepared also in the above-mentioned side-attachment-wall side, the chemical reaction of the side attachment wall by generating of the plasma inside this plasma production room can also be prevented.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing showing the condition that the sheet metal-like dielectric window was prepared on the top plate, with the sectional side elevation showing the configuration of the microwave excitation plasma treatment equipment concerning the gestalt of 1 operation of this invention.
[Drawing 2] Drawing showing the condition that the sheet-like dielectric window was prepared on the top plate, with the sectional side elevation showing the configuration of the microwave excitation plasma treatment equipment concerning the gestalt of this operation.
[Drawing 3] Drawing showing the condition of having prepared the dielectric window which has a taper in a top plate with the sectional side elevation showing the configuration of the microwave excitation plasma treatment equipment concerning the gestalt of operation of the second of this invention.
[Drawing 4] Drawing showing the condition of having prepared the dielectric window in the slot antenna of a stage configuration with the sectional side elevation showing the configuration of the microwave excitation plasma treatment equipment concerning the gestalt of this operation.
[Drawing 5] Drawing showing the condition of having prepared the dielectric plate in the interior of a plasma production room, with the sectional side elevation showing the configuration of the microwave excitation plasma treatment equipment concerning the gestalt of operation of the third of this invention.
[Drawing 6] Drawing showing the condition of having prepared the cylindrical shape-like dielectric plate in the interior of a plasma production room, with the sectional side elevation showing the configuration of the microwave excitation plasma treatment equipment concerning the gestalt of this operation.
[Drawing 7] Drawing showing the condition of having prepared the dielectric window in the slot antenna lower part side, with the sectional side elevation showing the configuration of the microwave excitation plasma treatment equipment concerning the gestalt of other operations of this invention.
[Drawing 8] For (a), in drawing showing the configuration of conventional microwave excitation plasma treatment equipment, the perspective view showing a whole configuration and (b) are a sectional side elevation.
[Description of Notations]
20 -- Microwave excitation plasma treatment equipment
21 -- Reaction container
22 -- Processed object
23 -- Plasma production room
24 -- Processing room
28 -- Wafer holder
30 -- Top plate
31 -- Waveguide
32, 40, -- slot antenna
33, 42, -- dielectric window

50 --- Dielectric plate
60 --- Stop section
70 -- Stop section

[Translation done.]